

What is claimed is:

1. A propulsion system, comprising:
a pressure vessel containing a propellant;
at least one axial thrust valve in communication with the pressure vessel and configured for selectively releasing gases generated by combustion of the propellant within the pressure vessel to provide axial thrust;
at least one maneuver control valve in communication with the pressure vessel and configured for selectively releasing gases generated by combustion of the propellant within the pressure vessel to provide thrust for maneuvering.
2. The propulsion system of claim 1, wherein the propellant comprises at least one solid propellant grain.
3. The propulsion system of claim 1, wherein the at least one axial thrust valve is configured as a proportional valve.
4. The propulsion system of claim 1, wherein the at least one maneuver control valve is configured as a proportional valve.
5. The propulsion system of claim 1, wherein the at least one axial thrust valve is in communication with a thruster located and oriented to provide axial thrust along a longitudinal axis.
6. The propulsion system of claim 5, wherein the at least one maneuver control valve comprises two maneuver control valves, each of the two maneuver control valves in communication with at least one thruster located and oriented to provide maneuver control.

7. The propulsion system of claim 6, wherein the two maneuver control valves each comprise a valve in communication with a mutually opposing thruster located on opposing sides of the longitudinal axis and oriented to effect a change in pitch responsive to selective operation of one of the two maneuver control valves.

8. The propulsion system of claim 7, wherein the mutually opposing thrusters are located in a common plane transverse to the longitudinal axis.

9. The propulsion system of claim 5, wherein the at least one maneuver control valve comprises four maneuver control valves, each maneuver control valve in communication with at least one thruster, the thrusters located offset from the longitudinal axis and oriented to effect a change in yaw or roll responsive to selective operation of at least one of the maneuver control valves.

10. The propulsion system of claim 9, wherein the thrusters are disposed as two mutually opposing pairs of thrusters, each thruster pair including mutually parallel thrusters.

11. The propulsion system of claim 10, wherein the mutually opposing pairs of thrusters are located in a common plane transverse to the longitudinal axis.

12. The propulsion system of claim 5, wherein the at least one maneuver control valve comprises four maneuver control valves, each of the four maneuver control valves in communication with at least one thruster located and oriented to provide maneuver control.

13. The propulsion system of claim 12, wherein the four maneuver control valves each comprise a valve in communication with a thruster located offset from the longitudinal axis and oriented to effect a change in at least one of pitch, yaw and roll responsive to selective operation of one or more of the four maneuver control valves.

14. The propulsion system of claim 13, wherein the four thrusters in communication with the maneuver control valves are located in a common plane transverse to the longitudinal axis.

15. The propulsion system of claim 13, wherein two of the four thrusters are oriented to provide opposing, parallel thrust offset to opposite sides of the longitudinal axis and the other two of the four thrusters are oriented to provide opposing, parallel thrust offset to opposite sides of the longitudinal axis and perpendicular to the two thrusters.

16. The propulsion system of claim 5, wherein the at least one maneuver control valve comprises eight maneuver control valves, each maneuver control valve in communication with a thruster located and oriented to provide maneuver control.

17. The propulsion system of claim 16, wherein the thrusters are disposed as four pairs of thrusters offset from the longitudinal axis, each thruster pair including mutually parallel thrusters opposing another thruster pair and located 90° circumferentially from two other thruster pairs.

18. The propulsion system of claim 17, wherein the pairs of thrusters are located in a common plane transverse to the longitudinal axis

19. The propulsion system of claim 2, wherein the at least one axial thrust valve and the at least one maneuvering valve are operable in combination for simultaneous opening to reduce pressure within the pressure vessel to a degree sufficient to terminate combustion of the solid propellant grain.

20. The propulsion system of claim 2, wherein the at least one solid propellant grain comprises a plurality of solid propellant grains mutually separated by a flame-inhibiting barrier.

21. The propulsion system of claim 20, further comprising at least one igniter separately associated with each solid propellant grain of the plurality.

22. The propulsion system of claim 2, further comprising at least one igniter grain associated with the at least one solid propellant grain.

23. The propulsion system of claim 22, wherein the at least one igniter grain comprises a plurality of separately actuatable igniter grains.

24. The propulsion system of claim 1, wherein the pressure vessel, the at least one axial thrust valve, and the at least one maneuvering valve are disposed within a common housing.

25. A method for extinguishing a solid propellant undergoing combustion within a pressure vessel of a propulsion system, comprising:
providing a plurality of valves in communication with the pressure vessel; and
opening the plurality of valves to reduce pressure within the pressure vessel to a degree sufficient to terminate combustion of the solid propellant.

26. The method of claim 25, wherein the providing a plurality of valves comprises providing at least one valve in communication with a thruster for providing axial thrust and at least two valves in respective communication with thrusters for providing thrust for maneuvering.

27. The method of claim 26, wherein providing at least two valves in respective communication with thrusters for providing thrust for maneuvering comprises providing two valves in respective communication with thrusters for providing thrust for pitch control and four thrusters in respective communication with thrusters for providing yaw and roll control.

28. The method of claim 25, wherein providing a plurality of valves comprises providing a plurality of proportional valves.

29. A propulsion system for propelling and maneuvering a vehicle, the system comprising:
a pressure vessel containing at least one solid propellant charge for generating gases through combustion thereof;
at least one valve in communication with the pressure vessel and with a thruster for providing axial thrust for the vehicle by release of combustion gases from the pressure vessel;
a plurality of valves in communication with the pressure vessel and respectively in communication with thrusters located and oriented for providing maneuver control for the vehicle, wherein each valve of the plurality is selectively operable to effect at least one of pitch, yaw and roll control of the vehicle through release of combustion gases through a thruster; and
wherein the at least one valve and the valves of the plurality are operable to open fully in combination to cause rapid depressurization of the interior of the pressure vessel to stop combustion of the solid propellant.

30. The propulsion system of claim 29, wherein the at least one valve is controllable to adjust and maintain substantially constant pressure within the pressure vessel during combustion of the solid propellant responsive to temperature fluctuations.

31. The propulsion system of claim 29, wherein the at least one valve and the valves of the plurality are each proportional valves.

32. The propulsion system of claim 29, wherein the at least one solid propellant charge comprises a plurality of solid propellant charges mutually separated by a flame-inhibiting barrier.

33. The propulsion system of claim 32, further comprising at least one igniter separately associated with each solid propellant charge of the plurality.

34. The propulsion system of claim 29, further comprising at least one igniter grain associated with the at least one solid propellant charge.

35. The propulsion system of claim 34, wherein the at least one igniter grain comprises a plurality of separately actuatable igniter grains.

36. The propulsion system of claim 29, wherein the at least one solid propellant charge comprises a plurality of solid propellant charges mutually separated by a flame-inhibiting barrier.

37. The propulsion system of claim 36, further comprising at least one igniter separately associated with each solid propellant charge of the plurality.

38. The propulsion system of claim 29, further comprising at least one igniter grain associated with the at least one solid propellant charge.

39. The propulsion system of claim 38, wherein the at least one igniter grain comprises a plurality of separately actuatable igniter grains.

40. A solid propellant dual phase rocket motor comprising:
a pressure vessel;
a first solid pulse grain disposed within the pressure vessel and having at least one pulse igniter associated therewith;
at least another solid pulse grain disposed within the pressure vessel, separated from the first pulse grain by a flame-inhibiting barrier and having at least one pulse igniter associated therewith;
a plurality of selectively operable valves in communication with the pressure vessel and having thrusters associate therewith.

41. The solid propellant dual phase rocket motor of claim 40, wherein the selectively operable valves comprise proportional valves

42. A rocket motor comprising;
a pressure vessel;
a solid propellant charge disposed within the pressure vessel for generating combustion gases;
a selectively operable axial thrust valve for release of the combustion gases from the pressure vessel; and
a plurality of selectively operable maneuver control valves for release of the combustion gases from the pressure vessel.

43. The rocket motor of claim 42, wherein the solid propellant charge exhibits the lowest possible steady state burn rate when the axial thrust valve is fully open and the plurality of maneuver control valves are fully closed.

44. The rocket motor of claim 42, wherein axial thrust valve and the plurality of maneuver control valves are sized to effect a rapid depressurization of the pressure during combustion of the solid propellant to terminate combustion thereof when the axial thrust valve and the plurality of maneuver control valves are fully open.

45. The rocket motor of claim 42, wherein the axial thrust valve and the plurality of maneuver control valves comprise proportional valves.

46. The rocket motor of claim 42, wherein the axial thrust valve is configured for modulation of the flow area therethrough to compensate for temperature effects to provide substantially constant axial thrust.

47. The rocket motor of claim 42, further including:
at least one additional solid propellant charge disposed within the pressure vessel and separated from the solid propellant charge by a flame-inhibiting barrier; and
at least one pulse igniter associated with the at least one additional solid propellant charge.

48. The rocket motor of claim 42, further including:
a source of flowable oxidizer; and
a control valve for selectively controlling flow of flowable oxidizer to the pressure vessel.

49. The rocket motor of claim 48, further including:
a source of ignition fluid; and
a control valve for selectively controlling flow of the ignition fluid to the pressure vessel.